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S I R:

Transmitted herewith for filing is: ☒ a new application
☐ a c-i-p application of S.N. _____ filed _____

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For **ELECTROMAGNETIC SHIELDING PLATE, ELECTROMAGNETIC SHIELDING
STRUCTURE AND ENTERTAINMENT SYSTEM**

Enclosed are:

- ☒ 7 sheets of drawings.(Figs. 1, 2A-B, 3, 4A-B, 5, 6A-B, 7)
☒ Specification, including claims and abstract (23 pages)
☐ Declaration
☐ An assignment of the Invention to _____
☒ A certified copy of Japanese Application No(s). 11-257791
☐ An associate power of attorney
☐ A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27
☒ Post card
☐ Recording fee (as indicated below)
☐ Information Disclosure Statement, PTO-1449, copies of _____ references
☐ Other _____
☐ Other _____

	Col. 1	Col. 2
FOR:	NO. FILED	NO. EXTRA
BASIC FEE		
TOTAL CLAIMS	26-20 =	6
INDEP CLAIMS	4-3 =	1
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIMS PRESENTED		

*If the difference in Col. 1 is less than
zero, enter "0" in Col. 2

SMALL ENTITY	
RATE	FEE
	\$345
x 9 =	\$
X 39 =	\$
x 130 =	\$
TOTAL	\$

OTHER THAN A SMALL ENTITY	
RATE	FEE
	\$690
x 18 =	\$
x 78 =	\$
x 260 =	\$
TOTAL	\$

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This invention claims a priority based on Japanese Patent Application No. 11-257791 filed on September, 10, 1999, the entire contents of which are incorporated herein by reference for all purposes.

The present invention relates to an electromagnetic shielding plate, an electromagnetic shielding structure, and an entertainment system having the electromagnetic shielding structure.

For example, in case where the box-shaped member covers the device-mounted surface of the printed board, the structure will be as follows. As a first step, a ground pattern is printed on the circumferential portion on the printed board. On the

other hand, an opening edge of the box-shaped member is turned outwardly to form a contact surface, which is then placed on the printed board. In this case, the box is located on the printed board so that the contact surface of the box comes into
5 contact with the ground pattern mounted on the circumferential portion of the printed board. In this situation, the box-shaped member is secured on the printed board by screwing or some other means.

In such a structure, electromagnetic radiation from the
10 device-mounted surface to the exterior of the equipment may be restrained since the device-mounted surface of the printed board is covered by the box-shaped member.

SUMMARY OF THE INVENTION

15 The shielding structure described above can ideally restrain electromagnetic radiation to the exterior of the electromagnetic equipment. However, in actually, there is a case where restraining effect for electromagnetic radiation is not exerted satisfactorily. In other words, product-to-
20 product variations in performance of electromagnetic radiation are found. According to the analysis carried out by the inventor of the present invention, it was found that such variations are caused by insufficient contact between the contact surface of the box-shaped member and the ground pattern. In other words,
25 there may be a warp or waviness in the printed board, thereby generating projections and depressions on the ground pattern.

Since the contact face of the box-shaped member cannot follow such a warp or waviness, a gap is created between the contact face and the ground pattern, through which electromagnetic wave may be radiated. Consequently, sufficient shielding is not performed.

It is possible to stop up the gap between the contact surface of the box shaped member and the ground pattern by means of soldering, whereby the gap may be closed almost completely. As a consequent, product-to-product variations in shielding performance may be prevented.

However, in this method, it is necessary to solder all around the circumference of the printed board. Therefore, "soldering" step is added to the manufacturing process. The added soldering step has a problem in that it takes time to carry out. Therefore, it is not practical to stop up the gap by soldering, except for special costly products. Therefore, this method is not generally employed.

Accordingly, the first object of the present invention is to provide a shielding plate that does not require special mounting step, is easy to mount, and can prevent radiation of electromagnetic wave independently of the state of the object to which it is mounted.

The second object of the present invention is to provide a shielding structure exhibiting a smaller range of product-to-product variations in shielding performance, and an entertainment system that can prevent radiation of

electromagnetic wave by such a shielding structure.

An electromagnetic shielding plate achieving the first object of the invention is an electromagnetic shielding plate for shielding electromagnetic wave by covering at least a part of an object comprising; a covering plate formed of a conductive plate, and a plurality of connecting strips provided along the edge of the covering plate, wherein the connecting strip is bent so that the tip portion thereof projects from the surface of the covering plate.

The electromagnetic shielding plate for achieving the second object of the invention comprises an object on which a circuit element is mounted, an electromagnetic shielding plate for shielding electromagnetic radiation by covering at least a part of the object, the object including a band-shaped ground pattern surrounding an area on which electromagnetic shielding is to be provided on a surface where the circuit element is mounted, the electromagnetic shielding plate including a covering plate formed of a conductive plate and a plurality of connecting strips provided along the edge of the covering plate, the connecting strip being bent so that the tip portion thereof projects from the surface of the covering plate, wherein the electromagnetic shielding plate and the object is kept in a positional relationship wherein the tips of the connecting strip are brought into press contact with the ground pattern.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a top view of an electromagnetic shielding plate according to the first embodiment of the present invention;

Figs. 2A and 2B are side views of the electromagnetic shielding plate according to the first embodiment of the present invention;

Fig. 3 is an explanatory drawing illustrating the positional relationship between the electromagnetic shielding plate and a printed board according to the first embodiment of the present invention;

10 Figs. 4A and 4B are enlarged views showing a portion where the leg portion of the electromagnetic shielding plate and a ground pattern on a printed board are in contact with respect to each other according to the first embodiment of the present invention;

15 Fig. 5 is an explanatory drawing illustrating the positional relationship between an electromagnet shielding plate and a printed board according to the second embodiment of the present invention;

20 Figs. 6A and 6B are enlarged views showing a portion where the leg portion of the electromagnetic shielding plate and a ground pattern of a printed board are in contact with respect to each other according to the second embodiment of the present invention; and

Fig. 7 is a sectional view of an entertainment system
25 having an electromagnetic shielding plate according to the
present invention.

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are brought into press contact with the ground pattern 201. The elasticity of the connecting strips 104 ensures that the tip 104a of the connecting strips 104 slightly open outward so as to exhibit warped shapes. There may be flux in the shape of thin film left on the ground pattern 201. In such a case, the flux should be scrubbed away before connecting them electrically. However, as described above, when the shielding plate 100 of the present invention is fixed to the printed board 200, the connecting strips 104 open outward, thus scrubbing residual flux away accordingly. It ensures the electrical connection between the shielding plate 100 and the printed board 200. Therefore, it is not necessary to remove the flux away in advance before the shielding plate 100 of the present invention is fixed onto the printed board 200. In other words, contact between the connecting strips 104 and the ground pattern 201 is ensured without removing flux in advance.

When the cabinet, which is not shown, is placed on a cabinet-fixing portion 110, the shielding plate 100 is applied with a load, which further ensures contact between the connecting strips 104 and the ground pattern.

As described thus far, since the respective connecting strips 104 are ensured to be in contact with the ground pattern 201, a high shielding effect can be obtained.

Fig. 5 and Fig. 6 show a second embodiment of a shielding structure of the present invention. The shielding structure according to the present embodiment comprises, as shown in Fig.

As in the first embodiment, the imaginary plane in which the tips of the connecting strips 305, 307 are aligned is located outside of the imaginary plane in which the tips of the supporting portions 311 and 312 are aligned. Therefore, when the printed boards 200 and 250 are fixed on and under the shielding plate 300, the first connecting strips 302 are brought into press contact with the ground pattern 201 of the lower printed board 200, and the second connecting strips 303 are brought into press contact with the ground pattern 251 of the upper printed board 250 respectively. Fig. 6 shows how it looks in such a state.

Since the shielding plate 300 serves to enhance the shielding effect than in the conventional case, even when two printed boards 200 and 250 are disposed one on another, electromagnetic induction generated between the two printed boards 200 and 250 may be prevented.

In this embodiment, each connecting strip is bent between its proximal end 304 and its distal end, so as to be L-shape in cross section. The overhanging length C from the proximal end 304 of the first connecting strip 302 to the bent position 305 may be set to be a different length from the overhanging length D from the proximal end 304 of the second connecting strip 303 to the bent position 305. For example, there is a case where it is preferable to displace the upper printed board 200 from the lower printed board 250 to an extent for the convenience of arrangement of substrate. In such a case,

the upper printed board 250 may be displaced from the lower printed board 200 toward the farther side of the drawing by arranging the strips in such a manner that the overhanging length C of the first connecting strip 302 on the nearer side of Fig.5
5 is shorter than the overhanging length D of the second connecting strips 303 on the nearer side, and the overhanging length C of the first connecting strip 302 on the farther side of the drawing is longer than the overhanging length D of the second connecting strip 303 on the farther side.

10 In the two embodiments described thus far, though the shielding plate is fixed onto the printed board by providing through holes onto the shielding plate and the printed board and securing them by a screw, the fixing method is not limited to this. For example, the tip of the supporting portion may
15 be provided with a locking portion for engaging with the printed board to secure them together, or they may be secured by clips or the like. It is also possible to secure them by eliminating the supporting portion from the shielding plate but providing it with through holes only, and providing the printed board with
20 supporting portions, so that they are secured together. Alternatively, it is possible to provide the shielding plate and the printed board with through holes, and secure them together by means of a member having an internal thread.

An entertainment system employing a shielding structure
25 will be explained referring to a figure as the third embodiment of the present invention. In this embodiment, a structure

having a shielding plate on a part of a surface of the printed board will be shown as an example.

The entertainment system 500 shown in Fig. 7 comprises at least an enclosure 505, a main control circuit substrate 510, a shielding plate 100, a pipe-shaped heat sink 530, a rectangular heat sink 540, a switch inlet unit 550, an electric power supply unit 560, and a memory card inserting portion 570. The main control circuit substrate 510 is provided with a circuit element including a central processing unit 511 mounted thereon. In this entertainment system 500, the main control circuit substrate 510 that generates the electronic wave most and the shielding plate 100 constitute the shielding structure.

A plate portion 121 of the shielding plate 100 is provided with a through hole 122, through which the rectangular heat sink 540 is inserted. The rectangular heat sink 540 constitutes a heat discharging mechanism with the pipe type heat sink 530 to prevent overheating of the central processing unit 511 in the main control circuit substrate 510.

The shielding plate 100 is connected to the main control circuit substrate 510 with the connecting strips 104 in press contact with the ground pattern to shield electromagnetic waves generated by the main control circuit substrate 510.

According to the present invention, there is provided the shielding plate that can be mounted easily without adding any special mounting steps, and can prevent electromagnetic radiation independently of the state of the object to which the

2 Claims 9, wherein said supporting portion comprises a connecting
3 portion for connecting said electromagnetic shielding plate
4 with said object.

1 11. An electromagnetic shielding plate according to
2 Claim 10, wherein said connecting strips projecting from said
3 covering plate are higher than said supporting portion.

1 12. An electromagnetic shielding plate according to
2 Claims 11, wherein said covering plate and said connecting
3 strip are integrally formed.

1 13. An electromagnetic shielding plate according to
2 Claim 8, wherein said covering plate and said connecting strip
3 are integrally formed.

1 14. An electromagnetic shielding plate according to
2 Claims 9, wherein said connecting strips projecting from said
3 covering plate are higher than said supporting portion.

1 15. An electromagnetic shielding plate according to
2 Claim 14, wherein said covering plate and said connecting strip
3 are integrally formed.

1 16. An electromagnetic shielding plate according to
2 Claim 1, wherein said covering plate and said connecting strip

19 said electromagnetic shielding plate and said object are
20 kept in a positional relationship wherein the tips of said
21 connecting strips are in press contact with said ground pattern.

1 25. An entertainment system according to Claim 24,
2 further comprising a supporting portion for establishing a space
3 between said electromagnetic shielding plate and said main
4 control circuit substrate, wherein said electromagnetic
5 shielding plate and said main control circuit substrate are
6 secured via said supporting portion.

1 26. An entertainment system according to Claim 25,
2 wherein the tips of said connecting strips projecting from said
3 covering plate is higher than said supporting portion in a state
4 where said electromagnetic shielding plate is positioned away
5 from said main control circuit substrate.

ABSTRACT OF THE DISCLOSURE

An electromagnetic shielding plate having high shielding effect is provided.

5 The electromagnetic shielding plate is formed of a conductive plate having elasticity and is provided on the edge thereof with a connecting strip bent in such a manner that the tip thereof projects from the surface of the plate, and with a supporting portion. When the electromagnetic shielding plate and the printed substrate are connected, it is ensured that the
10 ground pattern 201 of the printed board 200 and the connecting strip are brought into contact with respect to each other, thereby a high shielding effect can be obtained.

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FIG.2A

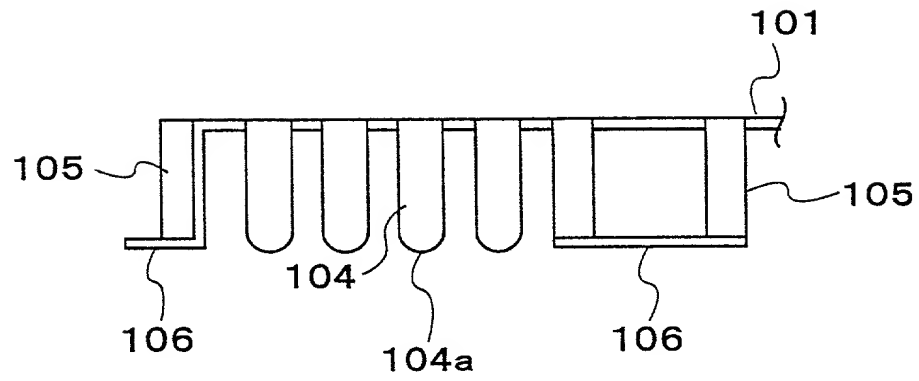


FIG.2B

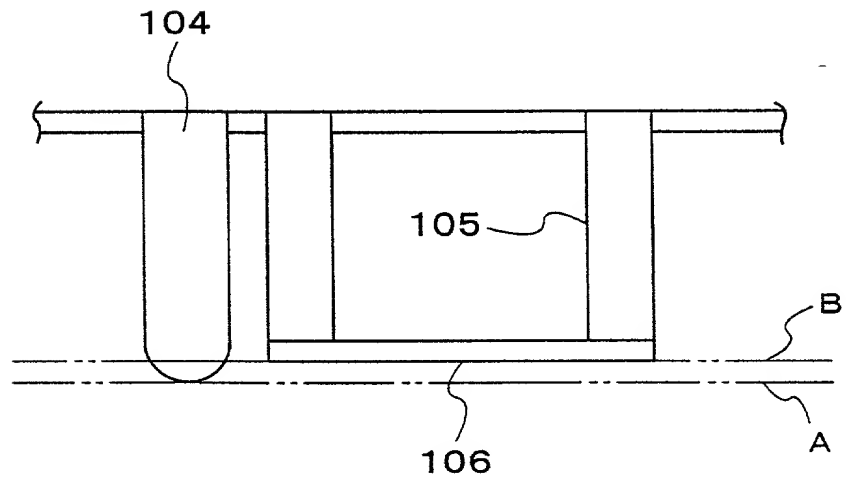


FIG.3

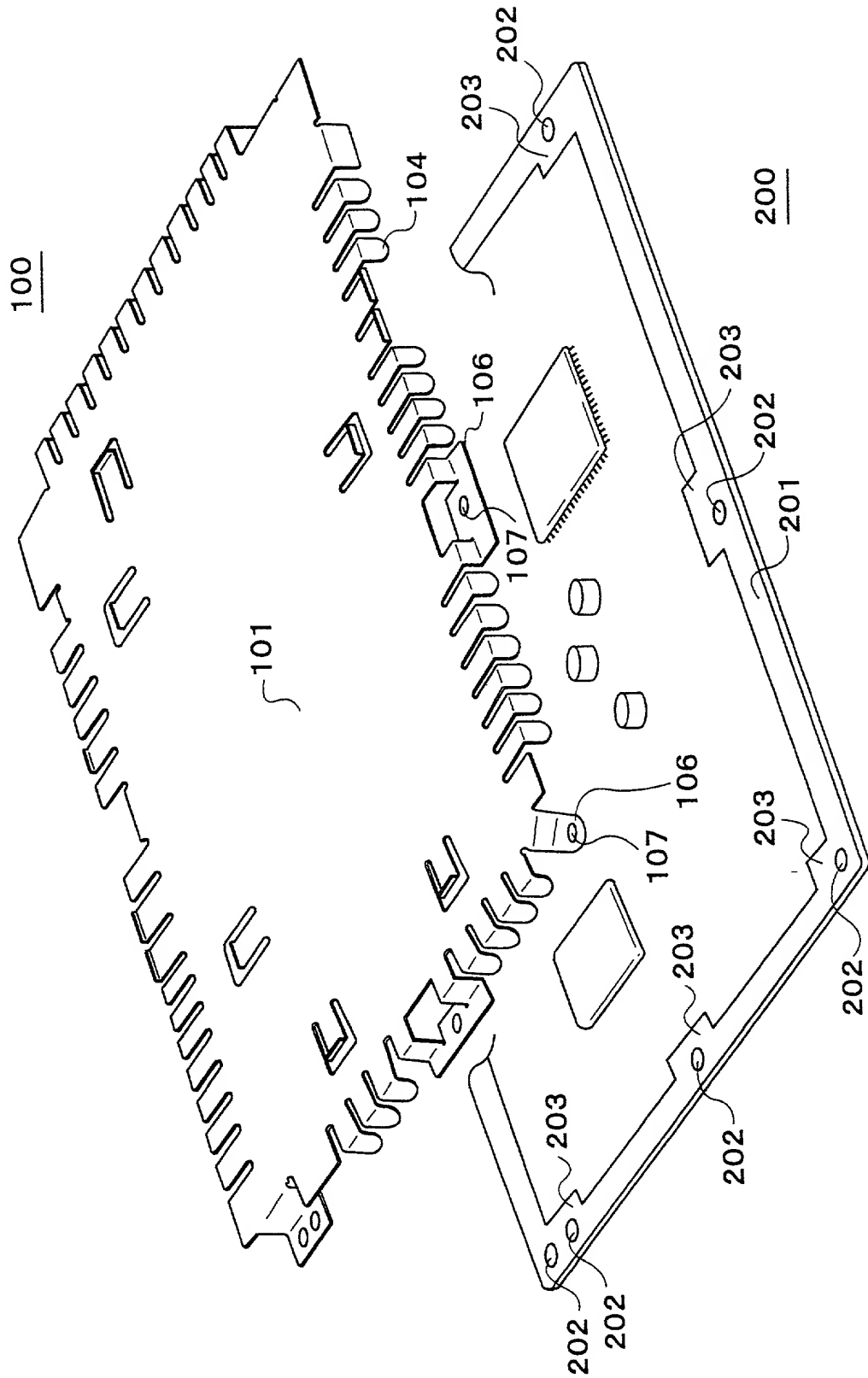


FIG.4A

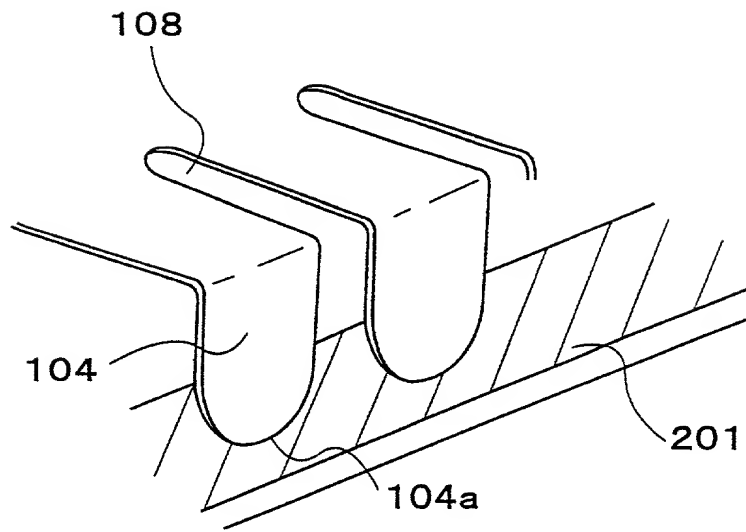


FIG.4B

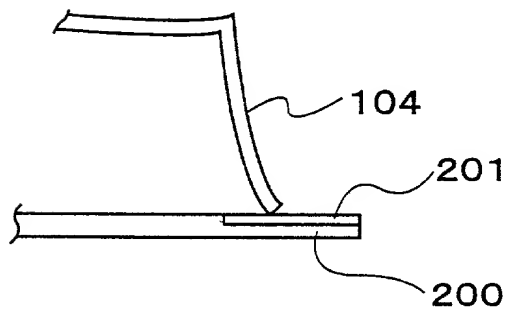


FIG.5

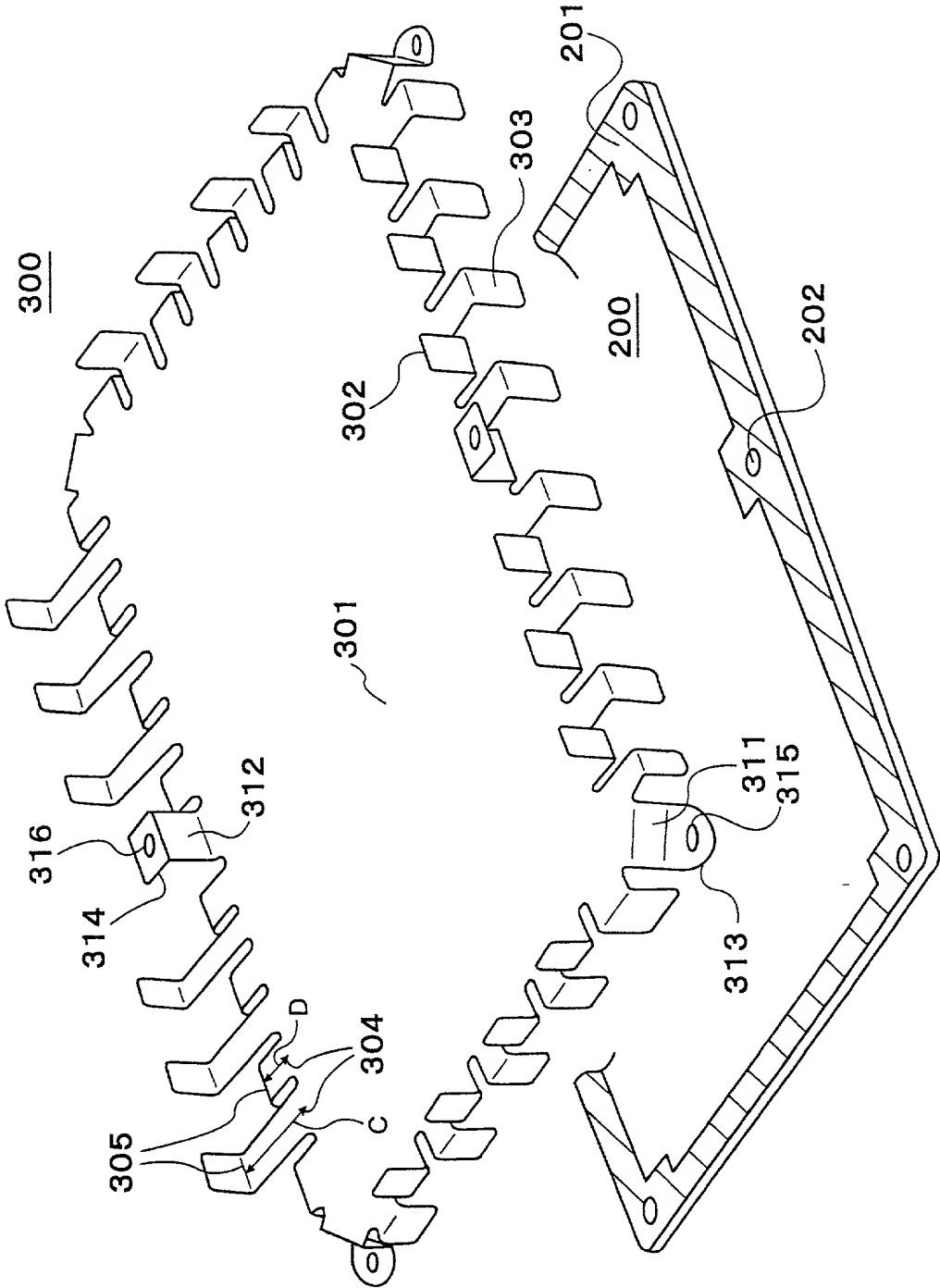


FIG.6A

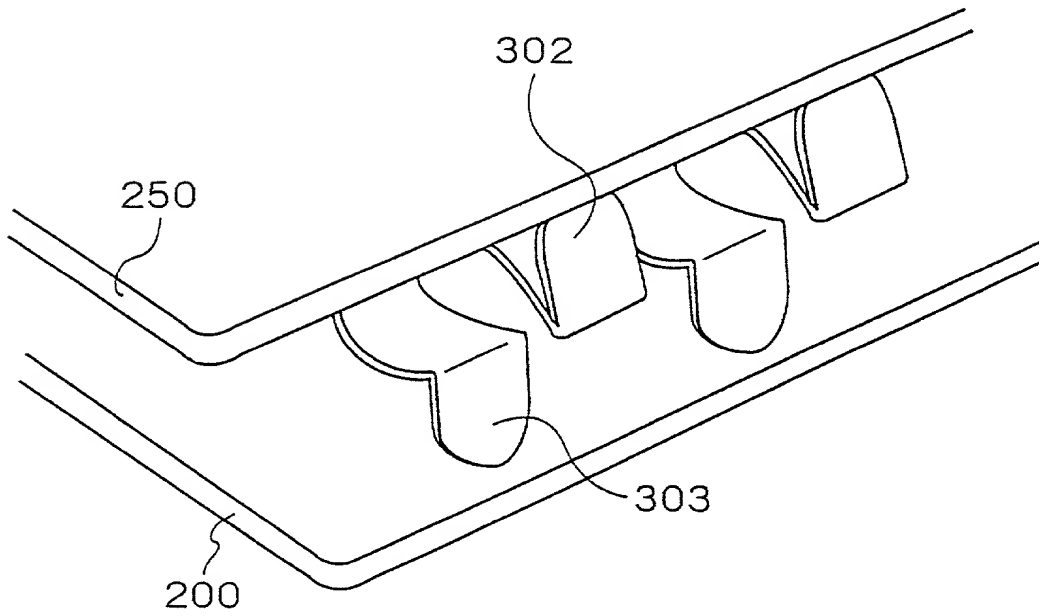


FIG.6B

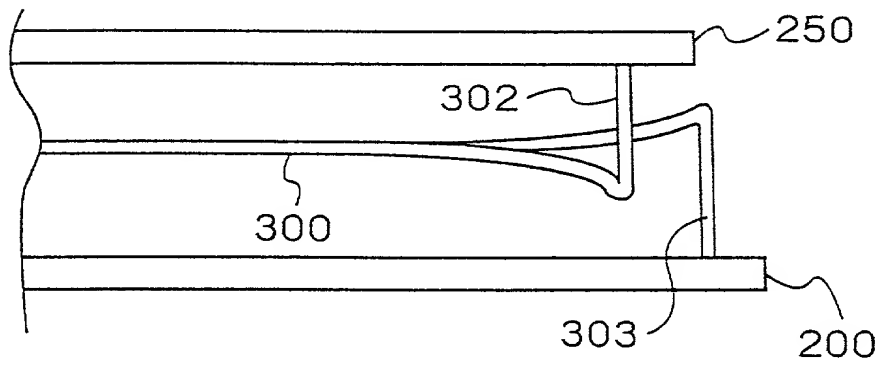


FIG. 7

